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GB 1470596
GB 1386085
GB 1189123
GB 1158311
GB 815028
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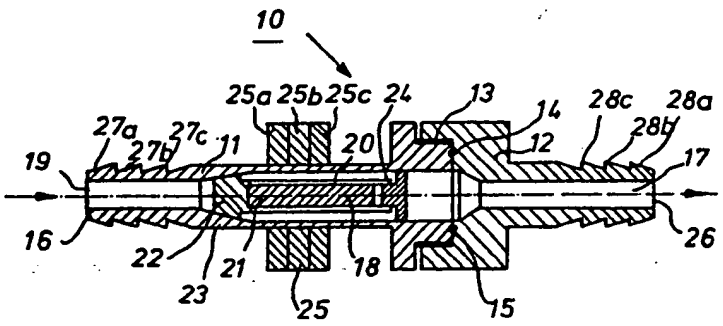
(54) Flow control valve

(57) A flow control valve is composed of two members (11, 12) which are threaded together. Members (11, 12) are provided with axially extending bores (16, 17) forming a chamber in which a valve element (18) is displaceable against a biasing force by a pressure differential across the valve. The element (18) comprises an elongate tubular member (20) housing a small bar (21) of permanently magnetic or ferromagnetic material. A permanent magnet (25), which may be composed of a plurality of components (25a, 25b) for the sake of controlling the magnetic flux, exerts the biasing force upon the magnetic material contained in the valve member (20). In this way the components (11, 12, 20) of the flow control valve may be manufactured of an inert or corrosion-resistant material such as glass, a polymeric material or the like.

Fig. 1



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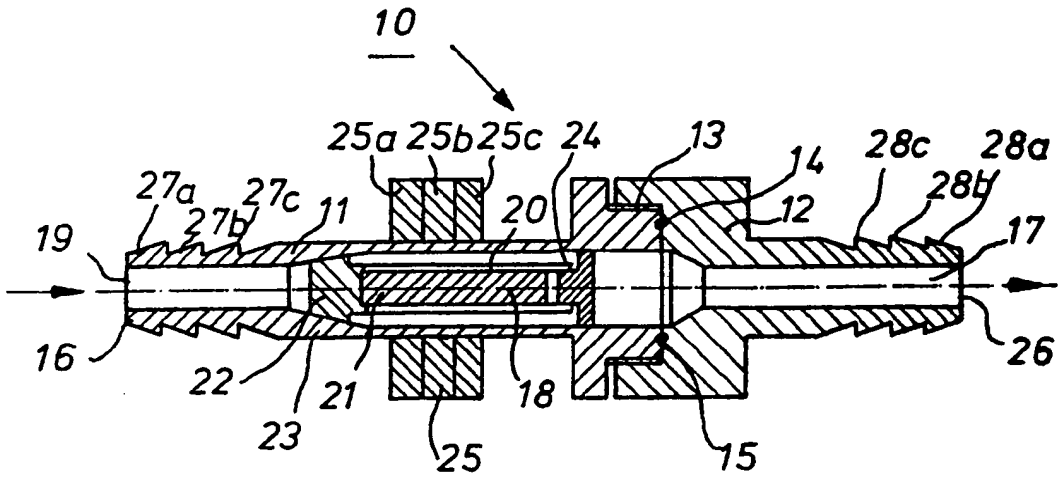
10
25a
25b
25c
24
13
14
28c
28a
28b
27a
27c
27b
11
20
12
19
17
16
26
22
21
18
23
25
15

Fig. 1

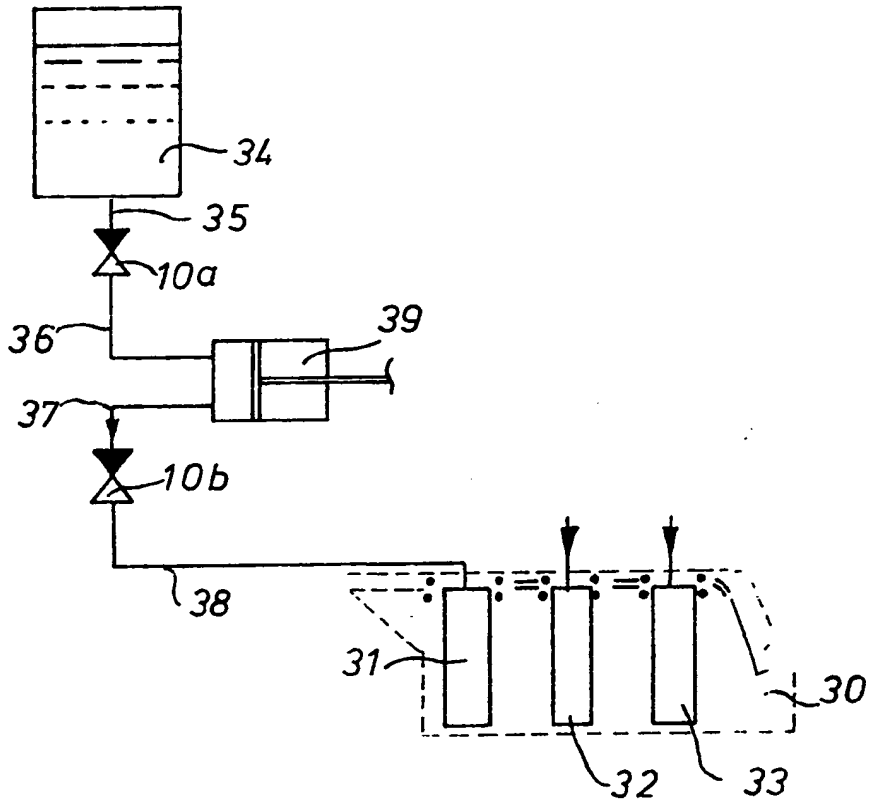
34
35
10a
36
39
37
10b
38
31
30
32
33

Fig. 2

SPECIFICATION
Flow control

This invention is concerned with fluid flow control valves. Fluid flow control valves serve for a lot of purposes and are widely accepted in the field of sanitary equipment and, in general, where fluid whether or not under pressure is stocked or transported.

Fluid flow control valves are also widely used in photographic processing equipment. They are incorportated in the fluid conduits supplying replenisher liquids to their associated processing stations in radiographic processing machines, and in apparatus for processing motion picture films, amateur films and papers and materials used in the graphic arts.

An inconvenience of prior art fluid flow control valves resides in the fact that their operation is dependent upon springs or electromagnets.

It is a disadvantage to rely solely on a spring for achieving a predetermined location of a valve element because the force exerted by the spring may decrease in function of time due to the gradual loss of elasticity of the spring. As a consequence, as in a spring-loaded shut-off valve for example, it generally happens that after a certain time the fluid tightness of the valve device in its closed position is no longer ensured and leakage occurs.

Fluid flow control valves which are controlled by electromagnets require an additional control circuit which renders their installation complicated and costly.

In the photographic arts, the problem of a timely closure is of particular importance when replenisher liquid in concentrated form has to be supplied to an associated processing station. The quantities of liquid to be dispensed in such circumstances are often very low so that a very small leakage can result in fluctuations of the processing cycle in question.

Moreover, as the number of fluid control valves used in photographic processing apparatus is relatively important, they constitute a substantial element of the costprice of the installation. The need for a low priced and reliable fluid flow control valve thus remains. It is therefore an object of the invention to provide a fluid flow control valve which does not show the aforementioned inconveniences.

According to the invention, there is provided a fluid flow control valve device comprising a valve casing wherein there is a valve chamber housing a valve element which can be displaced against a biasing force by a pressure differential across the device characterized in that the valve element is biased by magnetic force and the device incorporates or is associated with a permanent magnet exerting said biasing force.

In a preferred embodiment, the valve chamber is so designed and shaped that it provides a guidway for the valve element in its displacements.

For exerting the biasing magnetic force on the valve element, use may be made of one or more permanent magnets surrounding or distributed around the valve element, which is rendered magneto-responsive. For that purpose the latter element may be formed of or at least contain ferromagnetic or permanently magnetic material. Alternatively one or more bodies made of or containing ferromagnetic material may be provided, surrounding or distributed around the valve element, in which case the valve element itself is made of or contains permanently magnetic material.

The valve device may be constructed as a shut-off valve, the biasing force being so directed that the valve element is closed when there is no pressure differential or an insufficient pressure differential across the device. Alternatively the magnetic field may be directed so as to keep the valve element open until the biasing magnetic force is overcome by a pressure differential across the device.

The invention is not restricted to valve devices which are either normally fully closed or normally fully open under the biasing magnetic force. On the contrary, the invention includes devices suitable for other purposes, e.g. valve devices in which the valve element does not in any position shut-off fluid flow but is movable by or against the magnetic biasing force so as to reduce or increase fluid flow. The invention also includes valve devices which function as a switch-over valve, displacement of the valve element serving to switch fluid flow from one path to another.

In certain preferred embodiments of the invention the valve element itself has a tapered end which in one extreme position of the valve element co-operates with a valve seat to shut-off a fluid flow path through the device and the valve element is biased towards that extreme position by the permanent magnet(s). In modified embodiments, the tapered end of the valve element is provided or shaped with a passage so that a minimum flow of liquid is maintained when the valve element is in that extreme position.

Preferably the device incorporates a permanent magnet of annular or ring-like form surrounding the valve casing and/or the valve chamber. For example the magnet may surround the valve casing or it can be incorporated in the casing.

Preferably the device incorporates a permanent magnet which is of ring-like form which is mounted on and surrounds the valve casing. The casing may comprise two components defining aligned portions of a fluid flow path through the device, e.g. having axially extending bores which components make screw engagement with each other. A seating ring e.g. an O-ring may be interposed between the two components. In order that the device shall be suitable for controlling the flow of corrosive material, the two casing components may be made of an inert material such as glass or a polymeric material. When circumstances permit, a heat-sealing technique may be employed for fluid-tightly connecting the components. In an alternative construction of

valve casing, it comprises two identical moulded pieces, each forming a longitudinal half-section of the casing, the pieces being secured together by fusion or otherwise.

If the valve device incorporates a valve casing comprising two axially aligned components, one or more permanent magnets may be embedded or recessed into one of such components or may be clamped between them.

In order to provide for a kind of regulation of the magnetic biasing force to which the valve element is subjected, certain devices according to the invention incorporate a plurality of permanent magnets, or a permanent magnet in a plurality of component parts, which magnets or parts can be mutually relatively displaced.

Devices according to the invention can be constructed and used for the flow control of fluids in liquid or gaseous state.

An embodiment of the invention, selected by way of example, and an illustration of its use, will now be described with reference to the accompanying diagrammatic drawings, in which:

Fig. 1 is a longitudinal sectional view of a preferred embodiment of a fluid flow control valve device according to the invention, and

Fig. 2 shows the use of the fluid flow control valve of Fig. 1 in the distribution of photographic processing liquids towards a processing machine.

Referring to Fig. 1, the fluid flow control valve device comprises members 11 and 12, forming a casing, which are secured together by means of a thread-and-screw mechanism 13. Member 11 is provided with a circular recess 14 into which an O-ring 15 of adequate dimentions is provided for fluid sealing purposes. Members 11 and 12 are provided with axially extending aligned bores 16, 17 respectively, forming a valve chamber. The bores 16 and 17 show a divergence towards a relatively larger diameter portion of the bore 16 which forms a valve chamber. This chamber accommodates a valve element 18 which is capable of undergoing axial displacement under the influence of the pressure of fluid entering at inlet opening 19.

The valve element 18 comprises an elongate tubular member 20 housing a small bar 21 of permanently magnetic or ferromagnetic material. One extremity 22 of the valve element 18 is tapered in order to be capable to mate with the divergent part 23 of the axially extending bore 16 in order fluid-tightly to cut off the fluid flow through the latter. The divergent part 23 serves as a valve seat for the element 18. The difference between the maximum diameter of the divergent part 23 of the axially extending bore 16 and that of the tapered portion of the valve element 18 provides for a ring shaped space which is the work section of the valve. It will be clear that the valve seat may be constituted in some other manner, e.g. by a ring fitted in the bore 16.

If it should be required that a minimum flow of liquid can occur when the fluid flow control valve is in its closed position, the extremity 22 of the valve element may be provided with slits or holes through which a minimum quantity of fluid may flow away.

At its other extremity, the valve element 18 is provided with a plug 24 or other means which hermetically or liquid-tightly seals the interior of the element against entry of gas or liquid and at the same time cooperates with the peripheral wall of the valve chamber to assist in guiding the valve element in its axial movement.

The members 11, 12 and 20 may be made of an inert or corrosion-resistant material such as glass or a polymeric material. These materials provide for the advantage that, if desired, members 11 and 12 may be permanently secured to each other as, for example, by heat sealing. In the latter case the recess 14, the O-ring 15 and the thread-and-screw mechanism 13 may be omitted. The use of inert materials also enables the flow control of corrosive fluids.

In order to provide for the necessary biasing force urging the valve element 18 against its seat 23, a permanent magnet 25 is provided around member 11 according to a concentric configuration. The magnet 25 is slid around member 11. As a consequence, the lines of magnetic force which pass through the center of the magnet are guided through the axially extending bore 16 and through the bar 21 in the valve element 18. Under the action of the magnet 25, the valve element 18 undergoes a biasing force urging it against valve seat 23 so that the fluid flow control valve 10 is closed. Only when the pressure exerted at inlet opening 19 by the fluid to be transported exceeds the biasing force, the valve element 18 is lifted from its seat 23 and fluid flows towards exit opening 26. In order to provide for a regulation of the biasing force, the permanent magnet 25 may be composed of a plurality of permanent magnets 25_a, 25_b and 25_c which are displaceable relative to each other along the member 11, thereby enabling the regulation, between certain limits, of the concentration of the lines of magnetic force passing through the axially extending bore 16, and, consequently, the force which urges the valve element 18 against its seat 23.

By way of modification of the illustrated embodiment, the permanent magnet 25 can be replaced by a ring of a ferromagnetic material and the valve element 18 may incorporate or be made of a permanently magnetic material. Such a fluid flow control valve device will work as well as the one above described with reference to the drawing.

It will be clear that, if the polarity of the permanent magnet 25 is reversed, e.g. by installing the magnet in reversed orientation, (reversed through 180°) the fluid flow control valve element is permanently biased to open condition. A pressure difference occurring across the valve device may then act so as to close the valve device.

In order to facilitate reliable connection of the device to fluid flow conduits, members 11 and 12 are provided at their inlet, respectively outlet

with a plurality of cone-shaped projections 27_a, 27_b, 27_c . . . resp. 28_a, 28_b, 28_c over which a tube can be slid and fixed by means of a hose clamp (not shown).

Fig. 2 shows schematically how fluid flow control valves 10_a and 10_b according to the invention may be used in a replenishing system for a photographic processing apparatus 30.

For the sake of simplicity, only the replenishing of developer liquid will be described, because the principle of replenishing fixer and/or other liquids is of analogous nature. An elementary processing apparatus 30 comprises a developer tank 31, a fixer tank 32 and a washing tank 33 which are only schematically represented in cross section.

Replenisher liquid for the developer is supplied from storage tank 34 via conduits 35 to 38 and a volumetric pump 39 towards developer tank 31.

In the conduits 35, 36 leading to and the conduits 37, 38 going from volumetric pump 39 fluid flow control valves 10_a and 10_b according to the invention are provided.

During the aspirating stroke of volumetric pump 39, fluid flow control valve 10_a opens due to the fact that the pressure in conduits 36 and 37 and in the pump 39 drops. Due to the fact that in conduit 38 the atmospheric pressure still remains, fluid flow control valve 10_b remains closed so that replenisher liquid from storage tank 34 flows into the pump 39.

During the forcing stroke of pump 39, the pressure in conduits 36 and 37 rise above atmospheric pressure. As a consequence thereof, fluid flow control valve 10_a is closed, whereas fluid flow control valve 10_b opens so that replenisher liquid flows into developer tank 31.

The above described operating cycle is repeated until the required volume of replenisher liquid is fed into the developer tank 31. Then another control mechanism (not shown) stops the volumetric pump 39.

Analogous replenishing cycles may be carried out for every station forming part of the processing machine 30 and have therefore not been described.

CLAIMS

1. A fluid flow control valve device comprising a valve casing wherein there is a valve chamber housing a valve element which can be displaced against a biasing force by a pressure differential across the device, characterized in that the valve element is biased by magnetic force and the device incorporates or is associated with a permanent magnet exerting said biasing force.

2. A fluid flow valve device according to claim 1, wherein the valve chamber is shaped to provide a guideway for the valve element in its displacements.

3. A valve device according to any of the preceding claims, constructed as a shut-off valve, said magnetic force serving to bias said valve element towards its position in which it shuts off the fluid flow path through the device.

4. A valve device according to any one of the preceding claims, wherein the valve element has a tapered end which in one extreme position of said valve member cooperates with a valve seat to shut-off the fluid flow path through the device and said permanent magnet(s) bias(es) the valve element towards that position.

5. A valve device according to any of claims 1 to 4, wherein one or more permanent magnets surround(s) or is or are distributed around the valve chamber.

6. A valve device according to claim 5, wherein there is at least one said permanent magnet which is of ring-like form and which surrounds the valve casing and/or the valve chamber.

7. A valve device according to claim 6, wherein said permanent magnet(s) is or are mounted on said casing.

8. A valve device according to claim 6 or 7, in which there is a plurality of ring-like permanent magnets or magnet components and said magnets or components are capable of axial displacement relative to each other.

9. A valve device according to any of claims 1 to 4, in which a permanent magnet is incorporated in or forms part of said valve element and in which a ring of ferromagnetic material is mounted on and surrounds said casing.

10. A valve device according to any of claims 1 to 9, in which said casing comprises two components defining aligned portions of a fluid flow path through the device.

11. A valve device according to any of claims 1 to 10, wherein the casing is made of an inert material.

12. A valve device according to any one of the preceding claims in which said valve element comprises a part or parts forming a capsule which encloses material or a body responsive to the field of a permanent magnet.

13. A valve device according to any one of the preceding claims, in which the casing has axially aligned inlet and outlet passageways adapted to be connected to fluid supply and delivery sections of a fluid line.

14. A valve device according to any one of the preceding claims when used for controlling the flow of a replenisher liquid, preferably concentrated replenisher liquid, to an associated processing station in photographic processing apparatus.

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